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Research Product 90-08

Course of Action Assessment Tool (COAAT) Functional Description

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February 1990

Fort Leavenworth Field Unit
Systems Research Laboratory

U.S. Army Research Institute for the Behavioral and Social Sciences

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A Field Operating Agency Under the Jurisdiction of the Deputy Chief of Staff for Personnel

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This report documents the software functions of the Course of Action Assessment Tool (COAAT). COAAT is a computerized aid for assisting tactical operations officers in the assessment of various courses of action (COA). COAAT assists the analyst in organizing critical events (CE) according to his chosen method for analyzing the battlefield, analyzing the detailed actions of each COA, and in summarizing and comparing the results so the preferred COA may be identified.

COAAT was conceived and developed as a prototype for a field operating system. It is configured for operation in the laboratory environment of EDDIC (Experimental Development, Demonstration, and Integration Center) at the Army Research Institute Field Unit, Fort Leavenworth, KS. COAAT is written in Lisp and is operational on Symbolics 3675s and 3640s in the EDDIC facility. Although the current version of COAAT is not an artificial intelligence (AI) application, exercises using COAAT may reveal opportunities for the application of AI techniques.

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Course of Action Assessment Tool (COAAT) Functional Description

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FOREWORD

This document provides a description of a conceptual tool for assisting combat staffs in the evaluation of tactical courses of action. The prototype, referred to as the Course of Action Assessment Tool (COAAT), was developed in the Fort Leavenworth Field Unit's human performance command and control laboratory. The purpose of COAAT and its associated Tactical Planning Workstation is to provide an environment to look at officers using automated support for staff planning functions. Performance with these automated support tools is assessed in simulated tactical exercises to better determine requirements for maneuver and force level command and control systems. The tool may also be used for computer-based instruction to help staff students learn a structured approach to option evaluation. Prototype developments of this kind are necessary to determine the effects that automation will have on battlefield operations and define improved requirements for these systems.

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COURSE OF ACTION ASSESSMENT TOOL (COAAT) FUNCTIONAL DESCRIPTION

GENERAL DESCRIPTION

The Course of Action Assessment Tool (COAAT) is a computerized aid for assisting tactical operations officers in the assessment of various courses of action (COA). COAAT assists the analyst in organizing critical events (CE) according to his chosen methodology for analyzing the battlefield, in analyzing the detailed actions of each COA, and in summarizing and comparing the results so the preferred COA may be identified. These three primary functions of COAAT are organized into three functional modules:

- Module 1 - Critical Event Assignment
- Module 2 - Critical Event War-gaming
- Module 3 - Course of Action Comparison.

COAAT was conceived and developed as a prototype for a field operating system. It is currently configured for operation in the laboratory environment of EDDIC (Experimental Development, Demonstration, and Integration Center) at the Army Research Institute Field Unit, Ft. Leavenworth, KS. COAAT is written in Lisp and is operational on Symbolics 3675's and 3640's in the EDDIC facility. The current version of COAAT is not an artificial intelligence (AI) application; however, exercises using COAAT may reveal opportunities for the application of AI techniques. Procedures for running COAAT for EDDIC exercises are contained in Appendix A. In the EDDIC configuration COAAT has three operational modes:

- Training mode. This mode represents the prototype for a field operational system and all input comes from the using analyst. In the laboratory environment this mode is used for training exercise participants in the use of COAAT.
- Exercise mode. This mode is used for EDDIC computer-aided exercises. In this mode the analyst inputs data to the CE Assignment Module, but for exercise control pre-recorded data are presented to him for CE war-gaming in Module 2. This serves to limit the divergence between exercises thereby facilitating the comparison of exercise results.

- Demonstration mode. This mode is used for system demonstration and provides selected pre-recorded data for each of the modules. This mode requires limited input by the demonstrator, yet still demonstrates the full system capability.

COURSE OF ACTION ANALYSIS

COAAT is designed to support the tactical operations planning staff in analyzing tactical courses of action, one step of the staff planning process. The basic steps of COA analysis as stated in USACGSC, ST 100-9 are: war-game the courses of action, compare war-game results, and develop branches/sequels for each course of action.

The steps outlined by ST 100-9 for war-gaming courses of action are:

- Step 1. Gather The Tools. COAAT is one of the tools.
- Step 2. List All Friendly Forces. COAAT does not support this step.
- Step 3. List The Assumptions. COAAT does not support this step.
- Step 4. List Known Critical Events. A critical event is a specified or implied task, the completion of which is essential to mission accomplishment or which, in the judgment of the war-gamer, requires detailed analysis. Module 1 of COAAT provides the analyst with a means of listing the CE's and segregating them according to the chosen method of analysis, Step 5 below.
- Step 5. Select War-game Method. The term war-game method refers to the technique which the analyst uses to organize the area of operations for analysis or war-gaming. The methods outlined in ST 100-9 are avenue-in-depth, belt, and box. Any alternative technique of the analyst's own choosing may also be used. The analyst should select the method for war-gaming which is most useful to him given his own experience and the time constraints placed on the analysis. COAAT provides choices of avenue-in-depth, belt, or box for the method of analysis to be used. The grouping of CE's according to the chosen method of analysis is accomplished in conjunction with Step 4, above, within Module 1 of COAAT.
- Step 6. Select a Technique to Record and Display the Results. COAAT provides both the recording and display of results. Module 2 contains eight (8) objective (war-game outcome) assessment measures. The objective measures are: friendly

personnel casualties, friendly equipment losses, enemy personnel casualties, enemy equipment losses, POL expended, ammunition expended, FEBA movement, and battle duration. In Module 3 five (5) subjective measures are provided for consideration. Additionally, up to three other subjective measures may be entered by the analyst if desired. The five (5) given subjective measures are: accomplish the mission, effective use of assets, flexibility, facilitate future operations, and risk.

- Step 7. Visualize (War-game) the Battle and Assess the Results. The analyst should war-game each alternative friendly course of action against each probable enemy course of action considering the time constraints for the analysis. He should use the method of analysis selected earlier to organize his visualization. COAAT provides the means for recording the results of war-gaming each CE to include detailed outcomes for up to three phases of each CE.

Following the war-gaming of the CE's the analyst is ready to compare the courses of action. COAAT Module 3 assists in this comparison using both objective (war-game) assessment measures and subjective assessment measures.

During each step of the analysis, evaluation, and comparison of alternative courses of action, the analyst should identify modifications which would enhance the course of action under consideration. Once these modifications have been made, re-gaming may be necessary. COAAT facilitates this process of iteration through the analysis. During this process the analyst should also identify and analyze significant branches which might be necessitated by variations of events. Consideration must also be given to following missions and events (sequels) to insure the force will be able to carry out those actions. COAAT does not provide any direct assistance in these areas.

DETAILED DESCRIPTION

COAAT consists of three functional modules. The processes included in these modules are sequential in that data provided by the user in one module is required by the following module(s). Figure 1 depicts these modules and the subprocesses included in them.

User interaction with COAAT is accomplished through both the keyboard and the mouse. COAAT is controlled by the user through a series of menus. All menu selections are made using the mouse. All data entry is accomplished via the keyboard.

Initialization

When COAAT is started the first menu presented to the user is the selection of mission type. The mission type being analyzed determines the types of CE's which are listed on the menu presented in Module 1. Mission choices are: Offense, Defense, and Retrograde. In conjunction with this menu the user is given a brief explanation of COAAT which is expanded at each step. The instruction screen at this step is as follows:

```
    The first step in using COAAT is to specify the type of
mission being analyzed.  Next you must identify the critical
events (CE's) which will occur during the performance of the
mission and select the method you will use for organizing the
battlefield for analysis.  The CE's should be identified using the
Sun system in conjunction with a map and tactical overlay analysis
of the battle area.  CE identification should be entered on the
tactical overlay in the location at which you expect the CE to
occur (use control measure symbology).  The next COAAT menu will
ask for your selection of method of analysis; i.e., the way you
desire to group CE's for analysis.

Subsequent steps in the COAAT process will be:

      Selection and assignment of CE's to the appropriate COA's.
      War-gaming of the CE's, and
      Comparison of courses of action.

-- Using the mouse, select mission type from the menu below --
```

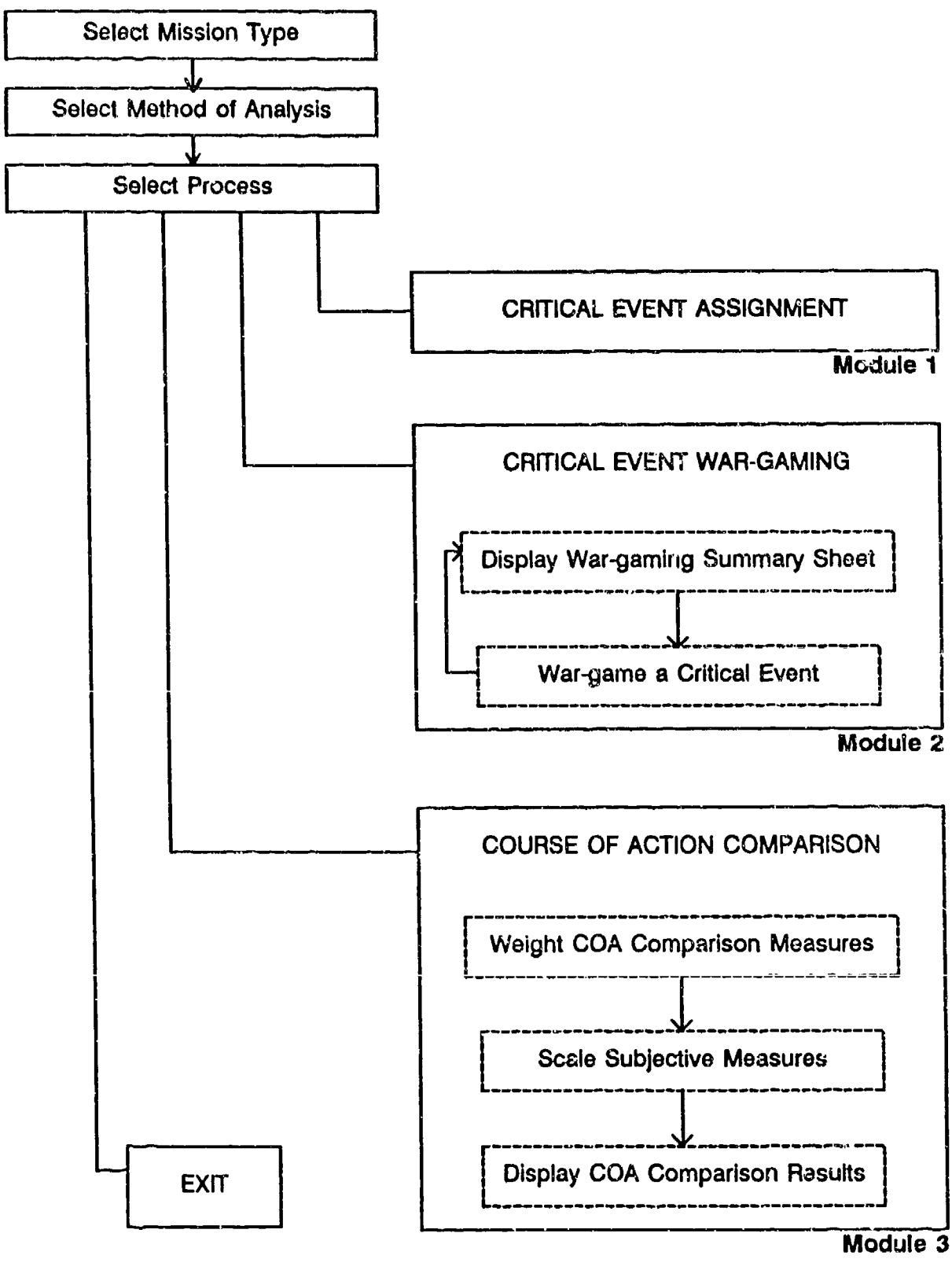


Figure 1. Functional diagram of COAAT.

When the mission type has been selected a menu will be presented for the selection of the method of analysis. The choices on the menu are: Avenue-in-Depth, Belt, and Box. The instruction screen presented with this menu is as follows:

War-Game Methods

Select your desired method of organizing the battlefield for analysis. The generally accepted methods are presented below for your consideration. When you assign the CE's to COA's, COAAT will group them in accordance with the method you have selected.

Avenue in Depth: The avenue-in-depth method focuses on one axis of advance at a time starting with the main effort. This method analyzes successive CE's along the main attack axis of advance until all CE's have been analyzed and all battle results have been assessed. Supporting attacks are analyzed in the same manner. Results along all axes are aggregated to evaluate each Course of Action.

Belt: The battlefield area is divided into successive belts generally parallel to the FEBA and running the width of the sector. CE's in each belt are analyzed and the results of all belts are summed to evaluate each COA. A modified belt technique in which belts are not contiguous may be used.

Box: The box method is a microanalysis of a few CE's or areas, and the battle analysis is focused on those CE's. The assumption is that all but a few CE's can be handled effectively and successfully, and only a few are analyzed to show their major impact on battle outcome.

-- Using the mouse, select desired method from the menu below --

When the method of analysis has been selected the main process menu for COAAT will be presented. This menu has the choices: Critical Event Assignment, Critical Event War-Gaming, Course of Action Comparison, and Exit. Each module of COAAT uses data which is input to preceding modules, the modules must be accessed in sequence initially. Once data has been entered into all modules they may be accessed in any order.

Module 1 - Critical Event Assignment

When "Critical Event Assignment" is chosen from the main process menu the following instruction screen is presented:

```
                    Critical Event Assignment

      The next step in using COAAT is to assign critical events
(CE's) to courses of action (COA's) and to group them in accord-
ance with your method for organizing the battlefield for analysis.
COAAT will present the COA's and the groupings you have desig-
nated.  You must input the CE identification, choose a CE type
from a menu, input the objective for that CE, and add any short
comment you desire.

-PRESS SPACE BAR TO EXIT THIS SCREEN TO THE CE ASSIGNMENT WORKSHEET-
```

Figure 2 depicts a display of the Critical Event Assignment Worksheet after entries have been made for two COA's with two avenues each. The first input required of the user is the main attack axis for COA 1. The following prompt is displayed for that input:

```
   Main Attack Axis

  Enter the letter
designator of the axis
which will be, or is
expected to be the
main attack for this
COA.

-- Press Return to
complete entry. --
```

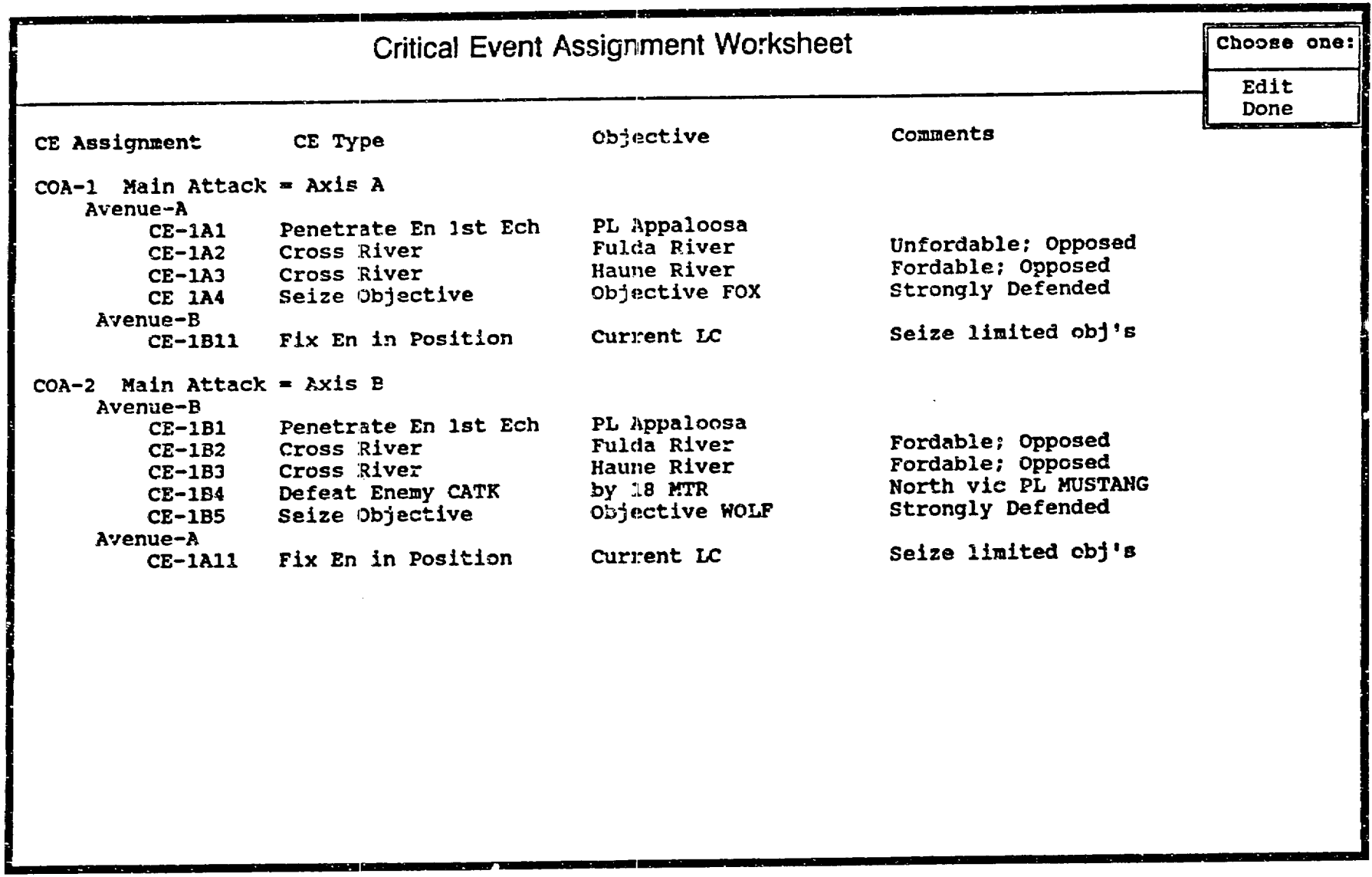
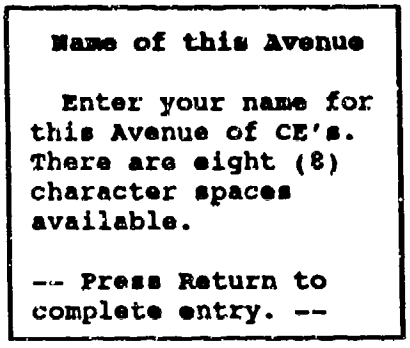
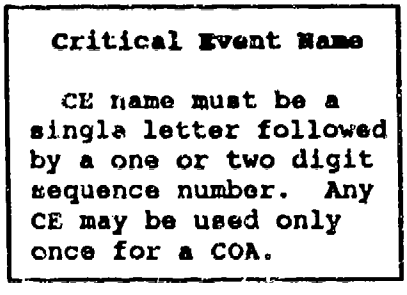


Figure 2. Critical Event Assignment Worksheet.

When input of the main attack axis is complete the term applicable to the chosen method of analysis, Avenue, Belt, or Box will be displayed and the user will be prompted for a name as follows (where the chosen method was avenue-in-depth):



The next input required by the user is the CE identification. The CE-#, where # is the COA number will be automatically displayed. The input identification is the axis designator and a one or two digit sequence number. A prompt is displayed only if an improper entry is made or if a duplicate CE number is input. The prompt is as follows:



Following entry of the CE number a menu of critical event types is presented for the user's choice of entry into that field. An "Other" choice is available for cases where none of the listed types is suitable. When the "Other" choice is made the user enters his own type from the keyboard, up to 20 characters. A "No Change" choice is also available and the cursor is automatically positioned on that choice when the field already contains data. When the CE type entry is completed the cursor advances to the Objective field for entry of the objective of the action at this particular CE. This is a 20 character keyboard entry. When the objective has been entered the cursor will advance to the Comments field for entry of

any comment the user desires. This field also has 20 character spaces available for keyboard input.

When the Comments field entry is complete, signaled by pressing the Return key, the cursor returns to the left margin and a menu is presented for choice of the next action. This menu offers the choices to Start New: Course of Action, Avenue (or Belt or Box), or Critical Event. The final option on this menu is Finished. The process is then repeated for the level chosen. When the Finished option is chosen a menu is presented which gives the user the option to edit the data he has entered or to leave Module 1 (Done). This menu is depicted in the upper right corner of Figure 2. The Edit option allows the user to step through the fields of the display and edit fields as desired. The Done option will return the main process menu of COAAT.

Module 2 - Critical Event War-gaming

When the "Critical Event War-Gaming" option is chosen from the main process menu the following instruction screen is displayed:

```
                    Critical Event War-Gaming

   The next step in using COAAT is to war-game the CE's and to
assess selected battle results.  Using your own war-gaming
technique or an available simulation you will war-game each CE
which you desire to analyze, assessing and recording battle
results for each in the available war-gaming worksheet.  COAAT
will sum and scale the battle results for each COA to facilitate
your comparison of them.

-PRESS SPACE BAR TO EXIT THIS SCREEN TO THE WAR-GAMING WORKSHEET-
```

When the instruction screen is exited the War-Gaming Summary Sheet, as depicted at Figure 3, will be displayed. This display lists all of the CE's which were entered in Module 1 and a set of war-gaming factors for consideration by the user. This display provides a summary of the war-game results with totals by Avenue (or Belt or Box) and COA.

Critical Event War-Gaming

Choose one:

War-Game a Critical Event
Exit the War-Gaming Module

WARGAMING SUMMARY SHEET

CE Type		Objective	Friendly Casualties Pers	Friendly Casualties Equip	Enemy Casualties Pers	Enemy Casualties Equip	Percent Expended POL	Percent Expended Ammo	FEBA Mvmt (km)	Time Rqd (hrs)
COA-1 Main Attack = Axis A										
Avenue-A										
CE-1A1	Penetrate En 1st Ech	PL Appaloosa	0	0	0	0	0	0	0	0.0
CE-1A2	Cross River	Fulda River	0	0	0	0	0	0	0	0.0
CE-1A3	Cross River	Haune River	0	0	0	0	0	0	0	0.0
CE 1A4	Seize Objective	Objective FOX	0	0	0	0	0	0	0	0.0
		Avenue Total	0	0	0	0	0	0	0	0.0
Avenue-B										
CE-1B11	Fix En in Position	Current LC	0	0	0	0	0	0	0	0.0
		Avenue Total	0	0	0	0	0	0	0	0.0
		COA Total	0	0	0	0	0	0	0	0.0
		Scaled Value	9	9	1	1	9	9	1	9
COA-2 Main Attack = Axis B										
Avenue-B										
CE-1B1	Penetrate En 1st Ech	PL Appaloosa	0	0	0	0	0	0	0	0.0
CE-1B2	Cross River	Fulda River	0	0	0	0	0	0	0	0.0
CE-1B3	Cross River	Haune River	0	0	0	0	0	0	0	0.0
CE-1B4	Defeat Enemy CATK	by 18 MTR	0	0	0	0	0	0	0	0.0
CE-1B5	Seize Objective	Objective WOLF	0	0	0	0	0	0	0	0.0
		Avenue Total	0	0	0	0	0	0	0	0.0
Avenue-A										
CE-1A11	Fix En in Position	Current LC	0	0	0	0	0	0	0	0.0
		Avenue Total	0	0	0	0	0	0	0	0.0
		COA Total	0	0	0	0	0	0	0	0.0
		Scaled Value	9	9	1	1	9	9	1	9

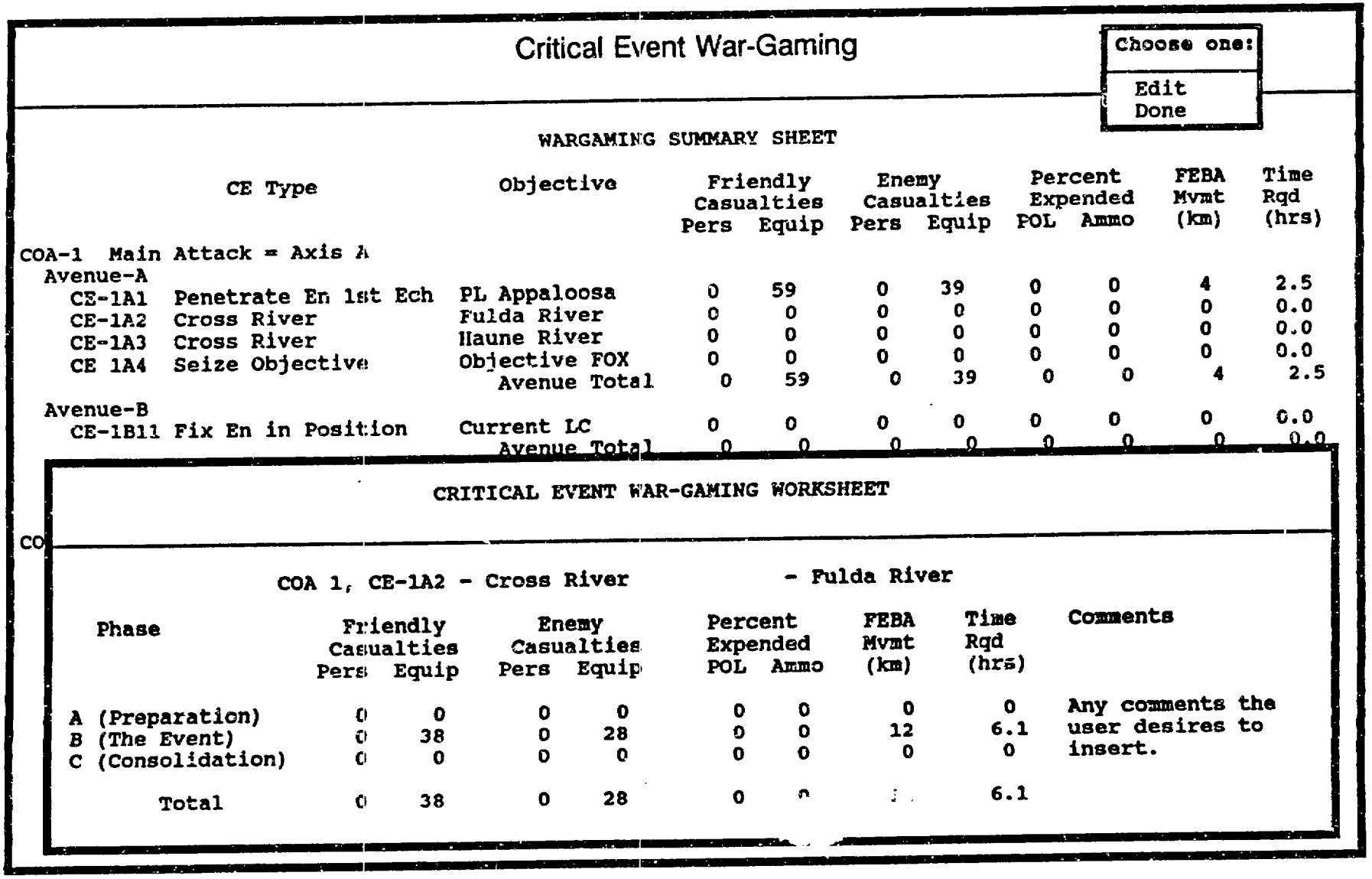
Figure 3. Critical Event War-Gaming Summary Sheet.

War-game result values are entered for each CE by choosing "War-Game a Critical Event" from the menu at the upper right of the display as shown in Figure 3. When this choice is made a menu listing all CE's is displayed for the user's choice of the CE to be war-gamed. CE's may be war-gamed in any order desired by the user, though the cursor is automatically positioned on the next listed (after any previously gamed) CE when the menu is displayed.

When a CE is selected for war-gaming the Critical Event War-Gaming Worksheet is displayed as shown in Figure 4. This worksheet provides for the input of values for three phases of the critical event. The preparatory phase consists of the actions leading up to the event itself; e.g., the approach to a river and establishment of the bridgehead. The actual event is the next phase and in this example might be establishing bridging and the actual crossing of the river. The consolidation phase is the final phase and consists of those actions necessary to regroup and prepare for continuing the mission. The user may use all phases or any subset of the three for input so long as he has considered all aspects of the entire action. Any or all of the war-gaming measures may also be used as desired by the user. The values to be entered for the war-gaming measures are defined in Table 1. The

Table 1
Units of Measure for Input of War-gaming Results

War-game Result	Units
Personnel losses	Numbers of persons
Equipment losses	Numbers of major equipment items
POL expended	Percent of division authorized load
Ammo expended	Percent of division basic load
FEBA movement	Kilometers
Battle duration	Hours and tenths of hours



Critical Event War-Gaming

Choose one:
Edit
Done

WARGAMING SUMMARY SHEET

	CE Type	Objective	Friendly Casualties Pers	Friendly Casualties Equip	Enemy Casualties Pers	Enemy Casualties Equip	Percent Expended POL	Percent Expended Ammo	FEBA Mvmt (km)	Time Rqd (hrs)
COA-1 Main Attack = Axis A										
Avenue-A										
CE-1A1	Penetrate En 1st Ech	PL Appaloosa	0	59	0	39	0	0	4	2.5
CE-1A2	Cross River	Fulda River	0	0	0	0	0	0	0	0.0
CE-1A3	Cross River	Haune River	0	0	0	0	0	0	0	0.0
CE 1A4	Seize Objective	Objective FOX	0	0	0	0	0	0	0	0.0
		Avenue Total	0	59	0	39	0	0	4	2.5
Avenue-B										
CE-1B11	Fix En in Position	Current LC	0	0	0	0	0	0	0	0.0
		Avenue Total	0	0	0	0	0	0	0	0.0

CRITICAL EVENT WAR-GAMING WORKSHEET

CO

COA 1, CE-1A2 - Cross River - Fulda River

Phase	Friendly Casualties Pers	Friendly Casualties Equip	Enemy Casualties Pers	Enemy Casualties Equip	Percent Expended POL	Percent Expended Ammo	FEBA Mvmt (km)	Time Rqd (hrs)	Comments
A (Preparation)	0	0	0	0	0	0	0	0	Any comments the
B (The Event)	0	38	0	28	0	0	12	6.1	user desires to
C (Consolidation)	0	0	0	0	0	0	0	0	insert.
Total	0	38	0	28	0	0		6.1	

Figure 4. Critical Event War-Gaming Worksheet.

values entered are automatically summed and when the CE War-Gaming Worksheet is exited they are displayed on the War-Gaming Summary Sheet. Scale values for the COA's are also calculated based on the current data and are displayed. The scale values are determined as shown in Table 2. The values shown in Table 2 were determined based on an expert solution and trial exercises for the current EDDIC exercise scenario. No fixed scale values can fit all possible analysis situations. An operational system will require flexibility in the determination of scale values appropriate to the situation being analyzed. Providing this flexibility will require additional input from the user. Possibilities include: user input of all scale values after the war-gaming is complete based on his own analysis of the COA results; or user input of the high and low bounds for the scale and the various scale values are interpolated over that range. Experience gained through the various EDDIC exercises should provide insight into the best approach.

When the last field of the War-gaming Worksheet (Phase C, Time Required) is completed a pop-up menu will appear in the upper right corner of the screen with the choices: Edit and Done. The "Done" choice will return the War-Gaming Summary Sheet, Figure 3.

When all CE's have been war-gamed the "Exit the War-Gaming Module" choice from the menu on the War-Gaming Summary Sheet, Figure 3, will return the COAAT main process menu.

Table 2

Scale Values for Objective Measures

Factor	Scale	Value
Friendly Personnel Losses (percent of auth = 21517)	9	<2
	8	2-4
	7	4-6
	6	6-8
	5	8-10
	4	10-12
	3	12-14
	2	14-16
	1	>16
Friendly Equipment Losses (percent of auth = 945)	9	<10
	8	10-18
	7	18-24
	6	24-29
	5	29-34
	4	34-38
	3	38-41
	2	41-43
	1	>43
Enemy Personnel Losses (percent of auth = 14020)	9	>16
	8	14-16
	7	12-14
	6	10-12
	5	8-10
	4	6-8
	3	4-6
	2	2-4
	1	<2
Enemy Equipment Losses (percent of auth = 879)	9	>43
	8	41-43
	7	38-41
	6	34-38
	5	29-34
	4	24-29
	3	18-24
	2	10-18
	1	<10

Factor	Scale	Value
POL Expended (percent auth load)	9	<50
	8	50-90
	7	90-125
	6	125-150
	5	150-170
	4	170-180
	3	180-190
	2	190-200
	1	>200
Ammo Expended (percent basic load)	9	<50
	8	50-90
	7	90-125
	6	125-150
	5	150-170
	4	170-180
	3	180-190
	2	190-200
	1	>200
FEBA Movement (km)	9	>38
	8	36-38
	7	34-36
	6	31-34
	5	28-31
	4	24-28
	3	18-24
	2	10-18
	1	<10
Time (hours and tenths)	9	<24
	8	24-26
	7	26-29
	6	29-32
	5	32-36
	4	36-42
	3	42-50
	2	50-60
	1	>60

Module 3 - Course of Action Comparison

When the "Course of Action Comparison" option is chosen from the main process menu the following instruction screen is displayed:

Course of Action Comparison

The last major process using COAAT is the comparison of alternative courses of action which have been analyzed so that a COA may be recommended to the Commander.

You will provide weights for the objective measures (war-gaming assessments) which you chose to use in war-gaming, as well as the subjective measures provide. The weights are relative among both objective and subjective measures used and reflect the relative degree to which each measure is deemed to affect mission accomplishment, as well as the degree to which each provides a basis for comparing COA's. The combination of weights and scales yields an overall quantitative merit of each COA and provides a basis for selecting a recommended COA.

This comparison along with a further comparison of advantages and disadvantages provides you the basis to recommend a COA to the Commander.

PRESS SPACE BAR TO EXIT THIS SCREEN AND BEGIN THE COA COMPARISON PROCESS

When the space bar is pressed the first screen of Module 3 will be displayed for input of weights for the COA assessment measures. Figure 5 is a sample of this screen. This screen is used to accept input of the relative importance weights for the COA assessment measures. The user may consider the objective and subjective measures independently or may consider them as one complete set when establishing weights. Note there are five subjective measures listed for user consideration as desired. There are also three user choice lines included which the user may make (enter) any measure desired, their use is not mandatory. The default value for all weights is zero (0); therefore, any measure can be eliminated from the COA scoring by simply pressing RETURN and leaving the 0 value. When the last (User Choice 3) weight value has been entered (zero or otherwise) a pop-up menu will appear in the upper right part of the screen with choices: Edit and Done. When the "Done" choice is selected the next screen of Module 3 will be displayed.

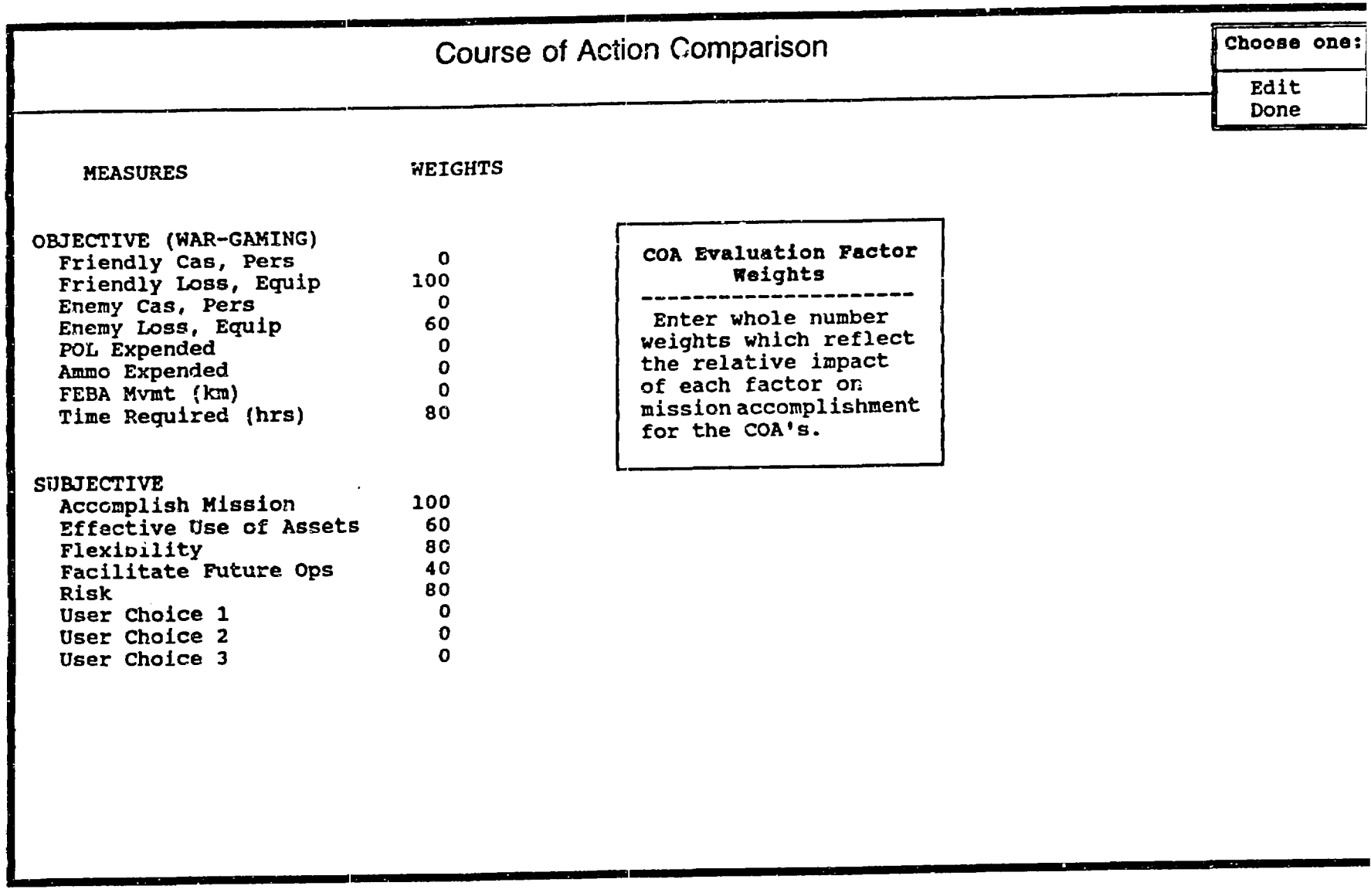


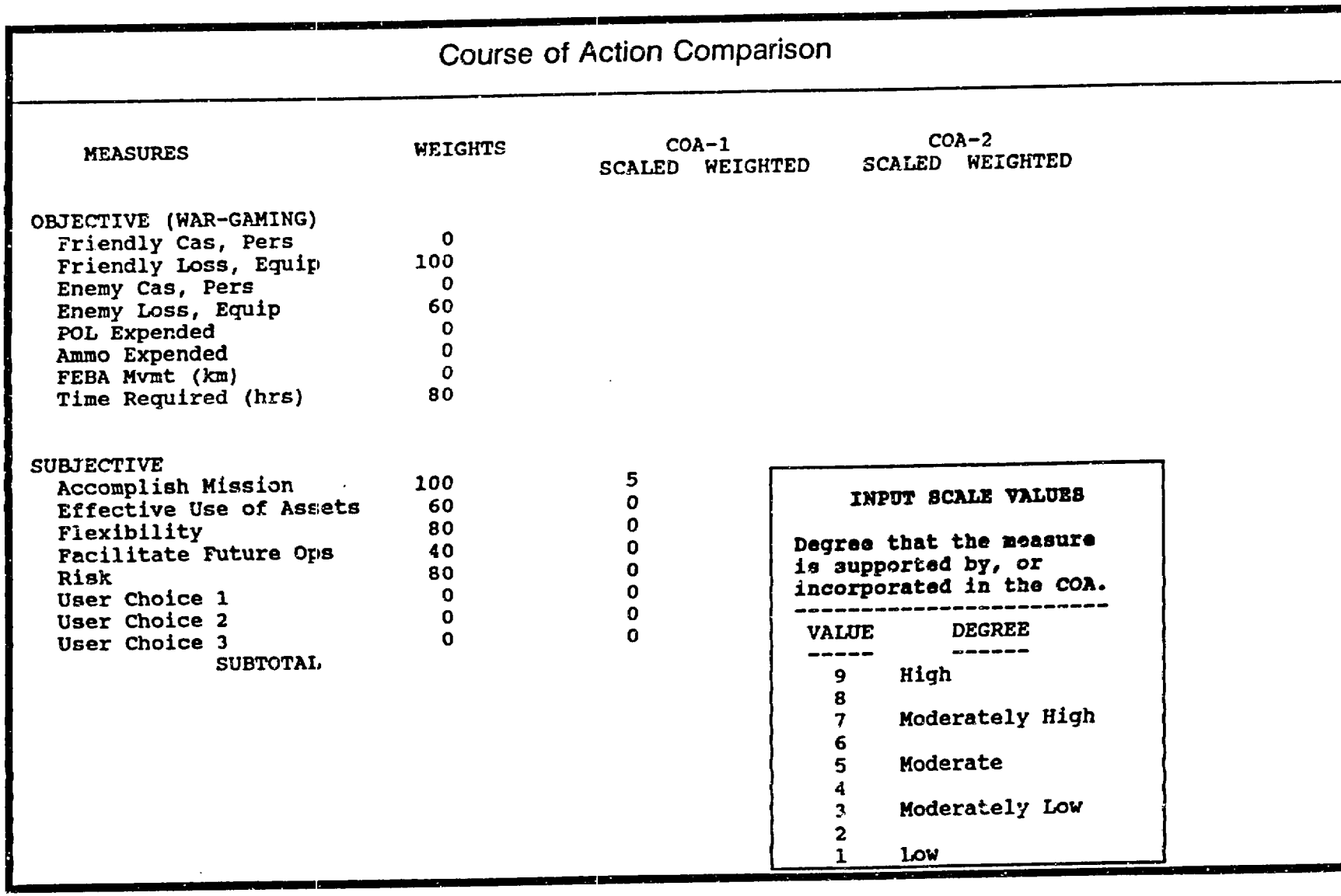
Figure 5. Display for input of weights for COA assessment measures.

The second screen of Module 3, shown at Figure 6, is for input of the scale values for the subjective measures. The scale values provide a relation between COA's for the measure being considered and reflects the degree to which the measure supports, affects, or is incorporated into each COA. The prompt shown in Figure 6 is displayed for all subjective measures except Risk. The prompt for Risk scale values is shown in Figure 7. When the last scale value (zero or otherwise) has been entered a pop-up menu will appear in the upper right portion of the screen with the options: Edit and Done. When the "Done" choice is selected the completed Course of Action Comparison screen will be displayed.

Figure 8 depicts the Course of Action Comparison screen. This display provides the analyst with weighted scores for each COA reflecting the weights of the assessment measures and the scales assigned to those measures for each COA. No total score is provided since the analyst may have chosen to consider and weight the objective and subjective measures independently. If the weighting considered all measures in a single relative scale, then a total weighted score may be used to compare the COA's.

A capability for performing sensitivity analysis of the assessment measure weights has recently been completed. This capability has not been approved for full integration into COAAT, but is available as a special feature. When this feature is activated it becomes a choice on the menu at the upper right corner of the COA Comparison screen, Figure 8. Appendix B describes the sensitivity analysis feature.

The COA scores must be evaluated by the analyst with a full understanding of his own considerations in weighting and scaling the measures. Only the analyst performing this analysis can determine if, and to what degree score differences are significant. With that knowledge and the consideration of other advantages and disadvantages COAAT should assist in arriving at a recommendation on the preferred course of action.



Course of Action Comparison

MEASURES	WEIGHTS	COA-1 SCALED	COA-1 WEIGHTED	COA-2 SCALED	COA-2 WEIGHTED
OBJECTIVE (WAR-GAMING)					
Friendly Cas, Pers	0				
Friendly Loss, Equip	100				
Enemy Cas, Pers	0				
Enemy Loss, Equip	60				
POL Expended	0				
Ammo Expended	0				
FEBA Mvmt (km)	0				
Time Required (hrs)	80				
SUBJECTIVE					
Accomplish Mission	100	5			
Effective Use of Assets	60	0			
Flexibility	80	0			
Facilitate Future Ops	40	0			
Risk	80	0			
User Choice 1	0	0			
User Choice 2	0	0			
User Choice 3	0	0			
SUBTOTAL					

INPUT SCALE VALUES

Degree that the measure is supported by, or incorporated in the COA.

VALUE	DEGREE
9	High
8	
7	Moderately High
6	
5	Moderate
4	
3	Moderately Low
2	
1	Low

Figure 6. Display for input of scale values for COA assessment subjective measures.

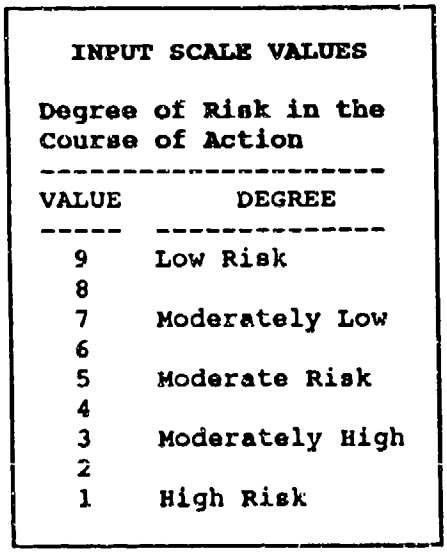
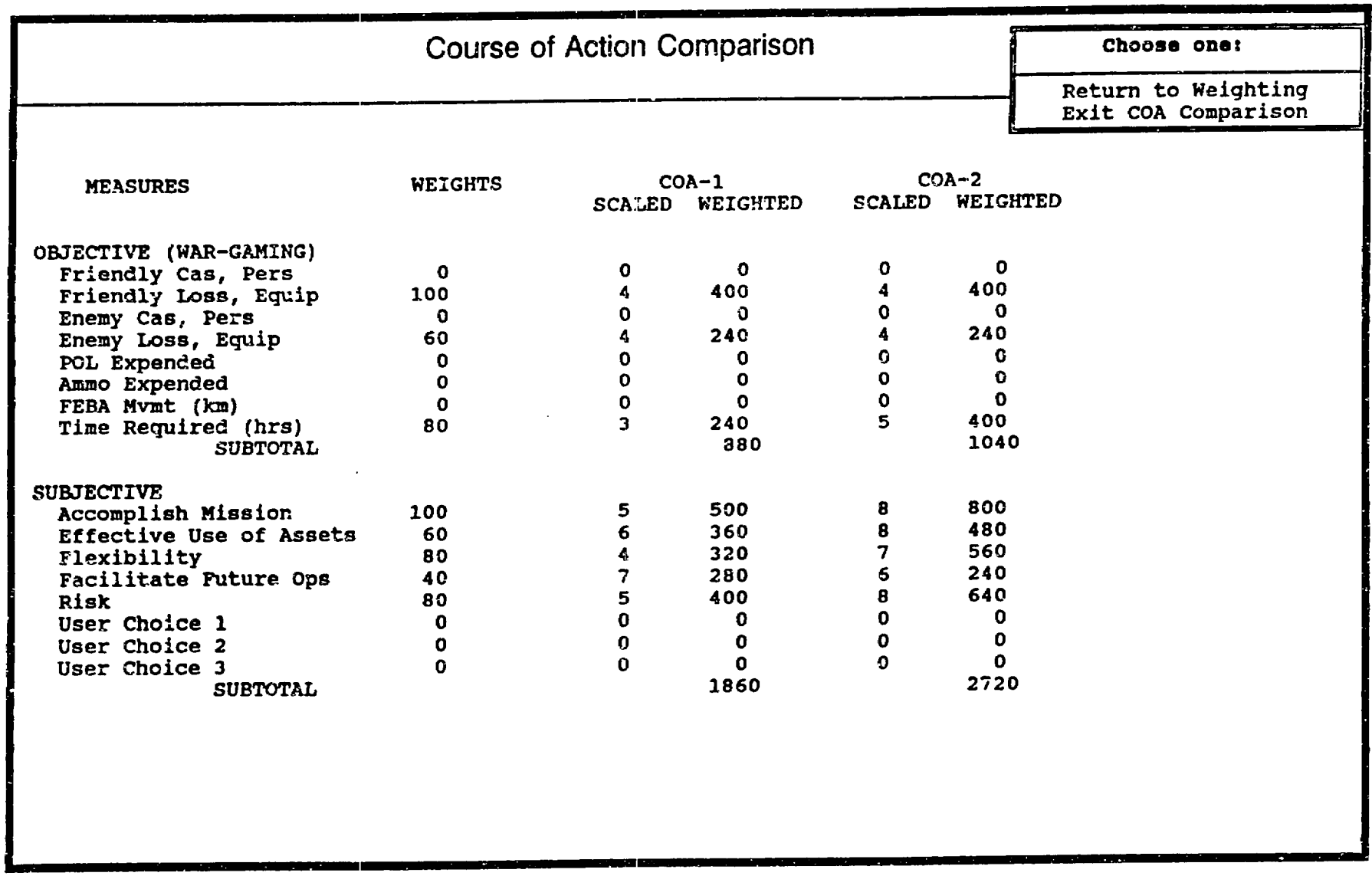


Figure 7. Prompt window for risk scale values.



Course of Action Comparison

Choose one:

Return to Weighting
Exit COA Comparison

MEASURES	WEIGHTS	COA-1 SCALED	COA-1 WEIGHTED	COA-2 SCALED	COA-2 WEIGHTED
OBJECTIVE (WAR-GAMING)					
Friendly Cas, Pers	0	0	0	0	0
Friendly Loss, Equip	100	4	400	4	400
Enemy Cas, Pers	0	0	0	0	0
Enemy Loss, Equip	60	4	240	4	240
POL Expended	0	0	0	0	0
Ammo Expended	0	0	0	0	0
FEBA Mvmt (km)	0	0	0	0	0
Time Required (hrs)	80	3	240	5	400
SUBTOTAL			880		1040
SUBJECTIVE					
Accomplish Mission	100	5	500	8	800
Effective Use of Assets	60	6	360	8	480
Flexibility	80	4	320	7	560
Facilitate Future Ops	40	7	280	6	240
Risk	80	5	400	8	640
User Choice 1	0	0	0	0	0
User Choice 2	0	0	0	0	0
User Choice 3	0	0	0	0	0
SUBTOTAL			1860		2720

Figure 8. Course of action comparison screen.

APPENDIX A

RUNNING COAAT FOR EXERCISES

1. Outline of Actions for Running COAAT for EDDIC exercises.

   a. Start COAAT, if required
   b. Initialize for Training Phase
   c. Initialize for Exercise Phase
   d. Save Exercise Data

2. General Comments.

Key references separated by a comma such as; SELECT, Z means press the SELECT key, release and then press the Z key.

Key references separated by a dash such as; control-ABORT means press the control key and while holding it down press the ABORT key.

The notation <CR> means press the RETURN key.

COAAT is controlled by menu choices made by the user. Menu choices are always made in COAAT using the mouse to get a box around the desired choice and pressing the Left mouse button. Pressing the Right mouse button will in most cases result in a system menu. Simply drag the cursor off and away from this menu and it will disappear.

Input of data is accomplished via the keyboard. Special keys used during input of data are as follows:

RETURN or TAB, complete the entry and advance to the next field in the forward direction;

BACKSPACE, complete the entry and move the cursor to the preceding field.

RUBOUT, deletes the character to the left of the cursor and puts the cursor on that space.

The COAAT screens are all made up of fields of data. Fields must be accessed in order, forward or reverse, by row all columns, then the next row. Forward is left to right and then

down. Random access of fields is not possible, to get to any particular field you must go through all intervening fields. You may go back and forth within the screen as desired until you press RETURN (or TAB) from the last field or choose Finished from the CE Assignment pop-up menu. In either case a menu will then be presented with the choices: Edit and Done. The "Edit" choice will return the cursor to the upper left field of the display and you may proceed as before. The "Done" choice will return the main process menu for selection of the next step as desired. Reentering a module from the main process menu is the same as choosing the "Edit" option before leaving the module.

COAAT can be run in three different modes; Training, Exercise, and Demonstration. The Training mode is the standard operating mode where all data is entered by the user. The Exercise mode allows user entry of CE's in the CE Assignment module, but reads in a stored set of CE data for use in the war-gaming and comparison phases. The Demonstration mode reads in stored data for all phases of COAAT. The choice of mode can be made when the COAAT system is originally started or when Exit is chosen from the COAAT process menu.

If the EXIT choice is selected from the COAAT main process menu you can return without losing data by choosing the Return option. If COAAT has been running in the exercise mode you will first be asked if data should be saved. Data should not be saved except at the end of an exercise. If you select any of the specific mode choices all data will be initialized and COAAT will be restarted at the Mission Selection menu.

3. Starting COAAT

If the machine is up and running, press SELECT, Z. If COAAT has already been loaded one of the COAAT screens will appear. If a COAAT window comes up then skip the rest of this paragraph and go directly to paragraph 4. Initialize COAAT for Training Phase.

If the machine is not running or needs to be booted, see paragraph 7. Booting the Symbolics. It needs to be booted if you see a prompt like; FEP: (or FEP0: or FEP1:).

It is Important that if the COAAT process is running; that is, SELECT, Z got you a COAAT window, DO NOT create another COAAT process. That would result in two processes running and the machine gets very confused.

If the machine has just been booted the displayed screen will be in the process called "Dynamic Lisp Listener". In other cases if you are not sure of the process you are in press SELECT, L. In this process you should see the prompt; Command: with the cursor next to the prompt.

At the Command: prompt enter the command

Load File M:>COAAT>COAAT <CR>.

At the next Command: prompt enter

(COAAT) [Note, no <CR> is required.]

This will load all the other files necessary to run COAAT and start the process in which COAAT will run. When the initial COAAT window is displayed the COAAT mode option menu will also be displayed. Choose the mode you want to run. The Return option will set the mode to Training. When this choice has been made the Command: prompt will be displayed in the bottom section. Start the COAAT program by entering:

(INIT-COAAT) [Note, no <CR> is required.]

4. Initialize COAAT for Training Phase.

If you have just started COAAT as described above, it is initialized and ready to start the training phase of an exercise.

If COAAT was already running it should be initialized to insure a clean start for the exercise. Do this by getting to the COAAT main process menu and choosing EXIT from this menu.

If the Exercise mode of COAAT has been running, you will be asked if the data should be saved, choose NO. (I assume that data will be saved at the end of an exercise and not at the start of the next exercise. Also, we don't want to save data if we don't know what it is.)

If any other mode of COAAT has been running, or after choosing NO to the save data question, a menu of COAAT modes will be presented. The choices are: Training, Exercise, Demonstration, Return, and Exit COAAT. Choose TRAINING. All data will be initialized and COAAT will be restarted in the training mode with the Mission Selection menu.

5. Initialize COAAT for Exercise Phase.

When the training session is completed, choose EXIT from the COAAT main process menu. This will result in the menu of COAAT modes, choose EXERCISE. This will result in a second menu for choice of data set to be used. Data sets are labeled A-B and B-A; A-B means COA 1 along Avenue A (north), B-A means COA 1 along Avenue B (south). This will initialize all data and start the exercise mode of COAAT at the Mission Selection menu.

6. Save Exercise Data.

When the exercise is completed the data created by COAAT should be saved. Choose EXIT from the COAAT main process menu. This will result in a menu "Save Exercise Data ?" with choices YES and NO. Choose YES. A small window will then appear for your entry of the exercise code. Codes have been preassigned for each exercise and the assigned code should be entered. These codes are generally made up of two letters followed by a one or two digit number.

When the code has been entered data will be saved to files labeled with the exercise code. At the same time files will be created with the data formatted for input to dBase IV. These files can be downloaded using routines on the Sun.

7. Booting the Symbolics.

If the machine has been turned off, power up by pressing the Power button on the machine.

If the machine is running and you see a Command: prompt then it does not need to be booted. Go to paragraph 3. Starting COAAT. It needs to be booted if you see a prompt like; FEP: (or FEP0: or FEP1:).

At the FEP: prompt enter:

H, space

The machine will provide a default of Hello.boot. Accept the default by pressing RETURN or if the default is different then enter: Hello.boot <CR>.

When it stops at the next FEP: prompt enter:

B, space

The machine will provide a default of Boot.boot. Accept the default by pressing RETURN or if the default is different then enter: Boot.Boot <CR>.

When the Command: prompt appears you should log in. Enter:

Login COAAT <CR>.

Now go to paragraph 3. Starting COAAT.

8. Crashes, Hangs, etc.

If the machine died from a power loss, then when power is restored just boot the system and start over. See paragraph 7, above.

If COAAT hangs up or crashes there are several things to try. First, select some other process and then return to COAAT. This can be accomplished by pressing SELECT, L (the Lisp Listener) and pressing SELECT, Z (COAAT).

If this didn't help, try to abort the process by pressing ABORT. If that doesn't do it, press control-ABORT. If one of these works there will probably be some output produced in the small section at the bottom of the COAAT window. If **more** appears in this section, press the space bar until all output has been produced. This should end with the Command: prompt.

If none of the above has worked, use SELECT, P. When the display comes up use the mouse to choose "Processes" from the menu at the top of the screen. This will provide a listing of all the processes currently in the system. Use the mouse to choose the "COAAT Window Flavor #" process (should only be one but the # could be something other than 1). Pressing the left mouse button will result in a menu with several options, choose Reset (left mouse) and verify when the verification prompt comes up. This will reset the COAAT process. Now return to COAAT using SELECT, Z.

Now you should have the Command: prompt in the bottom section of the COAAT window. If you want to (hopefully) retain any data that had been entered before the crash enter:

(START-IT) [Note, no <CR> is required.]

If you want to initialize and start COAAT from scratch then enter:

(INIT-COAAT) [Note, no <CR> is required.]

In either case the mode (Training or Exercise) that was running before the crash will be restarted.

9. Notes About Files for COAAT Data.

Two files are written by COAAT during an exercise, MOD1-OUT.Data and EXIT-OUT.Data. These files are written in directory M:>COAAT>. The file, MOD1-OUT.Data is written each time Mod 1 (CE Assignment) is exited. File, EXIT-OUT.Data is written when the Exit option is chosen from the COAAT main process menu.

Data files are archived and the dBase IV input files are created automatically when the exercise mode of COAAT is exited and YES is chosen from the "Save Exercise Data ?" prompt. The directory M:>COAAT-EXERCISE-DATA> has been established to archive the exercise data files. When files are transferred to this directory they are renamed to reflect the origin (mod1 or exit) and the exercise (exercise code number) to result in file names like MOD1-EXERCISE-CA##.DATA and EXIT-EXERCISE-CA##.DATA. Files containing data formatted for input to dBase IV are also stored in this directory. They are MOD1-DBASE-CA##.DATA (Mod 1, subject CE assignments), MOD2-DBASE-CA##.DATA (Mod 2, war-gaming summary data), SCALE-DBASE-CA##.DATA (scale value assignments from Mod 3), and WEIGHT-DBASE-CA##.DATA (factor weights assigned in Mod 3).

To backup files to tape, get the tape from the bookcase at the end of the computer room, second level, the only tape in with my papers and stuff. Put the tape into the drive on the machine. At the terminal use SELECT, L and then at the Command: prompt enter:

(tape:carry-dump "m:>coaat-exercise-data>*.*")

accept the default values by pressing RETURN.

APPENDIX B

SENSITIVITY ANALYSIS OF COURSE OF ACTION ASSESSMENT MEASURE WEIGHTS

GENERAL

A capability to perform sensitivity analysis on the course of action (COA) assessment measures has recently been completed. This capability has not yet been approved as an integral part of COAAT. All of the functions necessary to run the sensitivity analysis are loaded and available any time COAAT is run, but access is through a menu option in Module 3. The capability must be specifically turned on to add the choice to the menu. This can be accomplished by going to the Lisp Listener window (SELECT, L) and entering at the Command prompt:

(add-sensitivity-analysis)

Exercising this function will cause "Sensitivity Analysis" to be added to the menu in the upper right of the Course of Action Comparison Screen (Figure 8, page 21). Once activated the capability can be turned off by going the Lisp Listener window (SELECT, L) and entering at the Command prompt:

(delete-sensitivity-analysis)

The "Sensitivity Analysis" choice will be removed from the menu.

The sensitivity analysis capability was developed to provide the analysts using COAAT a quick evaluation of the weights assigned to the COA assessment measures. The sensitivity analysis will show the effect on the COA scores of changing the weight of any one measure. Sensitivity analysis results are computed within the categories, objective or subjective, to allow the analyst to consider them independently. Total COA score comparisons are left to the analyst.

The sensitivity analysis allows the analyst to establish a minimum and maximum weight for a specific measure. COA score results for the category are then displayed for weights at ten evenly spaced increments between these values. This output shows the analyst how sensitive the COA scores are to the weight assigned to that measure.

Sensitivity analysis can be selected (see above) from the menu on the COA Comparison Screen (Figure 8, page 21). When "Sensitivity Analysis" is selected from this menu the user is first asked, via a pop-up menu shown in Figure B-1, to choose the category of measures to be tested, Objective or Subjective. All menus and output displays are at the right margin of the COA Comparison Screen (Figure 8) so the entire comparison sheet is visible during the process.

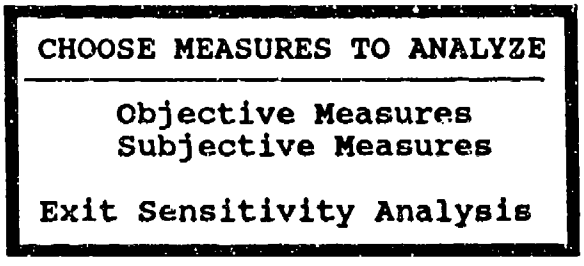


Figure B-1. Menu for choice of category of assessment measures.

When the desired category has been selected a pop-up menu will be displayed for the user to choose the specific measure for the sensitivity analysis. These menus are simply listings of the measures in the chosen category. Figure B-2 provides a sample for the Objective measures category.

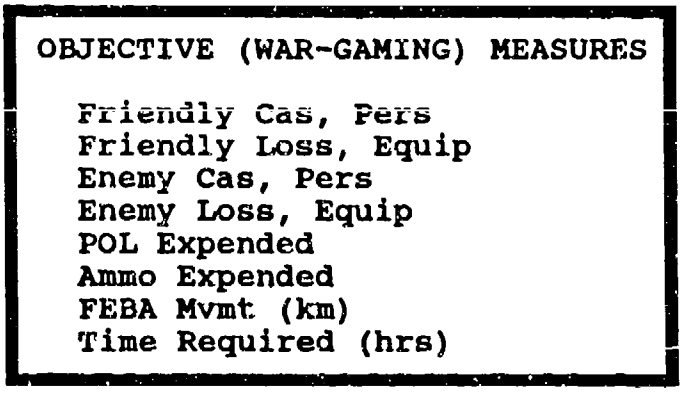


Figure B-2. Menu for choice of measure for sensitivity analysis.

When the specific measure has been selected the user is asked to supply minimum and maximum weight values to be applied. Figure B-3 provides a sample of this input window.

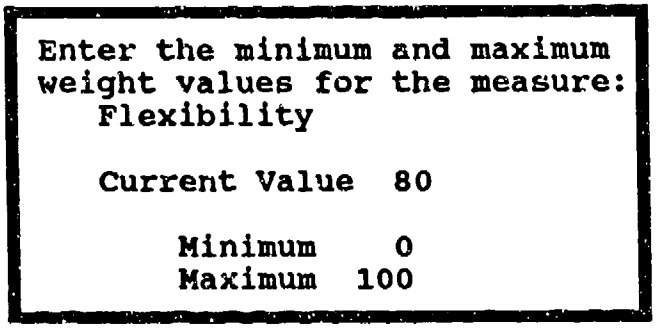


Figure B-3. Input window for minimum and maximum weight values.

COA score results will be calculated for the minimum weight value and ten (10) even increments up to and including the input maximum weight. A sample of the output display is shown at Figure B-4. The display shows the COA score results for the chosen category, objective or subjective, for variations in the weight of the chosen measure. The higher COA score is highlighted by an asterisks for a quick indication of any transition of the higher scored COA.

When this display is exited the menu for choice of category, Figure B-1, is returned. When the choice "Exit Sensitivity Analysis" is chosen from that menu the user is returned to the COA Comparison Screen as shown in Figure 8.

Flexibility

Current Values

Weight	COA-1	COA-2
80	2160.0	2280.0

Sensitivity Analysis

Weight	COA-1	COA-2
0.0	1804.0*	1720.0
10.0	1880.0*	1790.0
20.0	1920.0*	1860.0
30.0	1960.0*	1930.0
40.0	2000.0	2000.0*
50.0	2040.0	2070.0*
60.0	2080.0	2140.0*
70.0	2120.0	2210.0*
80.0	2160.0	2280.0*
90.0	2200.0	2350.0*
100.0	2240.0	2420.0*

- Space Bar to Continue -

Figure B-4. Sensitivity analysis results display.